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Run the race, leave a green trace

D2.3 Methodology for coaches to design and implement physical training programmes, tools and methods in the athletes' preparation and improve the performance

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Version 1[1], August 2024

[1] *The final version of the Methodology will be finalized following the feedback received from the Second Training Event planned in the Project*

SPORT PSYCHOLOGY for ENDURANCE and EFFECTIVE DEVELOPMENT of ATHLETS

Project number: 101133603, Project acronym: SPEED

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1. Introduction

The SPEED project is a collaborative initiative between the Sport Club for Athletics "Athletic" and the Rijeka Sports Association, aimed at advancing the field of sports training and psychology.

The SPEED Project addresses four specific objectives:

SO1: To enhance the skills of Sport Clubs Team to apply an effective physical and mental training programs;

SO2: To enhance the skills of the athletes to apply an effective self-preparation programmes for mental training;

SO3: To attract new participants with fewer possibilities to practice sport;

SO4: To establish international networking cooperation with institutions in the field of sport.

Trough comprehensive approach the project involves diverse target groups, including 30 sports clubs, managerial and coaching staff, 160 amateur athletes aged 7 to 29, 30 disadvantaged participants, their parents, and 30 sports organizations, along with four training and research institutions.

The expected outcomes of the SPEED project include enhanced expertise and knowledge within sports clubs, improved training program implementation, increased athlete proficiency in mental training, greater participation among disadvantaged groups, promotion of healthy lifestyles, and the establishment of robust international sports networks. Through these efforts, the SPEED project aims to foster a more inclusive and effective sports environment, benefiting a wide range of participants and stakeholders.

The concept of SPEED involves two core activities to be organised and held: 1. Trainings to exchange knowledge and practices if the field of sports training programmes and sport psychology and 2. Establishing international networking cooperation with institutions in the field of sport. In contemporary sports coaching, acknowledging the significance of sports psychology is important for optimizing athlete performance and achieving sustained success.

This methodology provides practical guidance on the general principles, concepts and methods for the coaches to design and implement physical training programmes, aiming at improving athletes' performance in sprinting track events. It provides an easy-to-follow matrix and a logical frame for the coaches to apply when designing physical training programme for an athlete. The methodology is best to be applied in synergy with the Methodologies for design and implement sports psychology tools and methods both for coaches and athletes, elaborated in the Speed Project.

The methodology deliberately uses a more practical approach to the presentation of information, less academically established concepts and terms, in order to provide an easy and comprehensible approach to every coach, regardless of his level of qualification and education.

2. General principles in designing physical training programmes for athletes

The main goal of a coach when working with an athlete is to create the best programme that will drive the needed adaptation for the athlete to reach his/her best potential in sport performance. While there are many approaches to drive a physical adaptation, not all of them are optimal as it might lead to injuries, mental breakdowns, lack and/or decrease in motivation, discipline, etc.

The fundamental "law" of a coach to work with an athlete should be as in the medicine "do no harm". Each training program needs be properly tailored to the age of the athlete and individual capabilities. The training programme should be designed in a balanced way, without excessive overload (i.e. not consistent with the current capabilities of the athlete) risking to compromise the health of the athlete.

The methodology provides basic practical concepts and methods for the coaches by applying four basic principles in their training programs, with the aim of providing a maximally effective training environment in which the primary focus is the health of the athlete.

Principles can be structured to:

- ✓ Progressive overload and periodization
- ✓ Balancing Specificity and Variation
- ✓ Application for Adaptation
- ✓ Individualization

All these principles should be applied in a holistic way in every aspect of the athlete health - **physical training, mental training protocols, proper nutrition, recovery are all needed for the best results to be achieved**. While this methodology focuses on the physical preparation of an athlete, an excellent would comprise all of these aspects and not considering only the physical preparation of the athlete.

As for the physical training, one of the most important components a coach should consider, is **the adaptation that the programme tries to drive in the athlete's performance.**

For the purpose of this methodology, the physical adaptations through exercises are defined and structured **in 6 basic categories:**

- Skills (learning or improving movement)
- Speed

- Power
- Strength
- Hypertrophy
- Conditioning/endurance.

When designing the optimal physical training programme, with the goal to achieve the best possible performance of an athlete, **a good approach would be to structure the programme based on the adaptations the coach would like to achieve in the athlete on a macro (as an end goal) and on a micro level (as part of the separate periods within the programme)**. I.e. in the focus of the sprint events at the macro level the goal would be to improve the athlete's qualities regarding speed, while at the micro level, in the individual periods of the program to work on conditioning, power, strength, etc.

For the clarity of the Methodology when term "exercise" is used, it reflects all the tasks that an athlete should perform as part of a training programme.

3. Application of the principles in Track and Field sprinters' preparation

3.1 Progressive overload and periodization

Active and intentional increase in progression as the athlete progress through a training protocol. Focusing on achieving overload and adaptation by progressing from general concepts to more sport/track event' specific concepts.

Progressive overload - as a general rule of thumb for increasing the load and from an injury prevention perspective, coaches should plan for such increases to be within the limits of up to 10% on a weekly basis. More than that can negatively impact training and might lead to: stop making progress; increase injury risk; more likely for the athlete to burnout. It is important in periodization and programme design over long periods of time.

A proper deload should be designed in the programme as well, with a general rule to avoid going through training for more than 6 weeks without deload (50% reduction in one or combination of variables, described in section 5)

Two main components of the progressive overload:

A. Gradual increase in stress created in the body: by proper and balanced modification of one or a combination of those variables: intensity; load; volume; reduction in rest intervals; workout complexity (*the modifiable variables are described in p. 5 below*);

B. Modification from general to specific (i.e. according to the time of the sports season):

- from general physical preparation (off season, i.e. large range of motion practices) to more specific actions and challenges of the sprinting track event (closer to the competition season, modifying exercise choice to mimic the range of motion close to the sprinting event performance);

- energy systems and demand of the sprinting track event– from basic conditioning to event specific;

- muscle action: (time on eccentric, concentric, isometric muscle action as part of the programme design) offseason – more general activation of muscle groups; progressing to pre-season more precise on specific muscle groups activation.

Progression and periodization strategy – the coach should build the strategy according to the goal and adaptation desired (conditioning, endurance, strength, power, etc.) within the specific timeframe: Focusing the progression and the periodization on the outcome for the respective part of the athlete's preparation. For example, if at the beginning of the training programme (pre-season) the goal is improvement of the general conditioning, the modifiable variables should put an emphasis on that goal.

3.2 Balancing Specificity and Variation of Exercises

When designing the physical training programme coaches need to consider how to maximise short- and long-term training by balancing the specificity and variation of the exercises in the programme. Both will lead to faster adaptation of the athlete but applied in unbalanced approach will compromise the health of the athlete, thus posing risk for injuries.

Exercise	Benefits	Cons
Specificity	More adaptation faster	Too much/extreme specificity lack enough variation which leads to increased chance of injury, unstable foundation; not addressing limitations of the athlete's body within weekly parts of the programme (i.e. asymmetry, weak low back, etc.). Doing only specific movement pattern will lead to compromising long-term training as it does not address limitations
Variation		Too much variation lack specificity and while limiting the injury risk, does not allow for the adaptation needed for the best sport performance as there is not enough stress to specific muscle groups or movement patterns.

Optimal combination of exercise specificity and variation should be in line with the required/desired adaptation (skills, speed, power, strength, hypertrophy, conditioning/endurance), considering the time and periodization as well – i.e. off-; pre-season; daily/weekly goals depending on the approach set by the coach. For example, if the goal is working on strength, the programme might put the focus on the intensity and load requirements (the specificity that drives the strength gains), reducing the volume; while for conditioning purposes the emphasise might be on the volume allowing more variations

within the training, lowering the intensity. Balancing those two variables might comprise both daily training sessions and longer periods of the training programme.

Understanding what adaptation (in that time period/week/day of the programme) the coach wants to achieve in the athlete, will provide the best design of the training programme though using variation and specificity to the athlete advantage.

3.3 Application for Adaptation

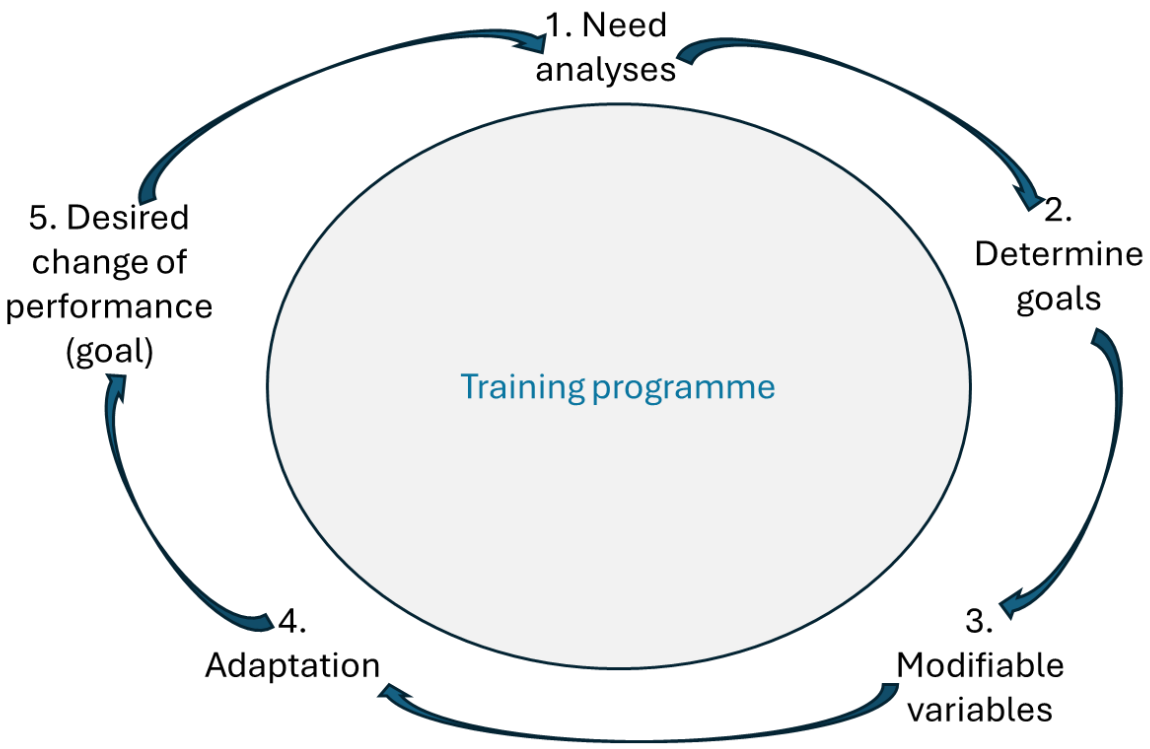
Exercises are not the only thing that will determine adaptation. Application of exercises determines adaptation.

For example, biceps curl, deadlift, snatch and jogging might each lead to specific adaptation if applied correctly (for the outcome desired). So how do the athlete do an exercise: repetition ranges, load and intensity, frequency, range of motion – all these will determine different adaptations for one and the same exercise. As in the previous principles mentioned above, the programme design in terms of application of exercises should address the specific goals of the programme as per the timeframe and periodization. As a further example, if the goal of a training session/week is to improve power and strength, a box- jump performed by applying sets of "as many reps as possible and with minimum resting period", will not lead to achieving the desired adaptation (power, strength), but rather it will improve the athletes conditioning. On the contrary, if the goal is to improve the athlete's conditioning, the same execution (as many reps as possible and with minimum resting period) might be optimal.

How an exercise is executed will determine the actual outcome.

Still the coach should not select the exercises solely on the adaptation. When selecting exercises a coach might apply a 5-steps cycle of programme design:

1. **Need analyses**: testing and defining the athlete's skills/abilities/movement patterns, where they are great at, what type of exercise do they perform better/worse. It might be defined by testing, by the coach or specified by the athlete.
2. **Determine goals** – where we are trying to go with the training programme, what do we want to achieve (on macro and micro level, general goal and specific, for example weekly goals). The "SMART" technique for defining goals: specific, measurable, attainable, realistic, timely.
3. **Modifiable variables in the programme**: *choice of exercises, order of exercises, volume, intensity, frequency, rest, progression, execution* – variables that based on how the coach modifies them, it will modify the desired outcome/goal.
4. **Adaptation** – Defining what physical adaptation we want to achieve through the performance of the exercise.
5. **Desired change of performance/Goal**



Following the steps in the cycle, reaching step 5, the coach might do a reassessment and to run the cycle once again from step 1 (based on the reassessment done). It would provide the coaches with the tool to modify/change the programme and to run the 5-step cycle again in compliance with the new goal set, until reaching peak performance.

3.4 Individualization

Once the coach has applied all the above-mentioned principles, the programme needs to be individualized to the specific needs of the athlete: athlete goal; balancing the programme in order to avoid overuse injuries or other detrimental adaptations, taking into consideration other specifics like:

Considering Time and calendar – what time the coach has ahead to work with the athlete to achieve the goal; major life events in the athlete's life, like graduation, marriage, tough exams, etc. and adjusting the programme around that as well. For example, some deload weeks might be designed around such events allowing the athlete to be away from strict programme but still working on physical performance with more flexibility on the programme.

The individualization itself might include details defined by the coach specifically for a respective athlete, like:

- ✓ type of equipment;
- ✓ personal/social specifics that should be considered when working with the athlete;
- ✓ time to commute to sessions;
- ✓ previous training experience of the athlete – what worked and did not work for that athlete before;
- ✓ giving (or not) some autonomy of the athlete in the programme design and to what extent, allowing the athlete to define preferences in some/any modifiable variables of the programme; it is a tool to improve the adherence of the athlete, if needed.
- ✓ other.

4. Monitoring and assessment of the programme

As with every goal, the training programme of an athlete should be subject of monitoring and control, which will provide the base for the proper assessment of the efficiency and effectiveness of the programme itself.

Setting the specific tools, timing and methods for monitoring and control of the performance is probably one of the most important parts of the programme, as if it cannot be measured and controlled, the coach and the athlete will have no idea if improvement/adaptation is achieved.

As the main goal of a coach-athlete tandem will always be optimal sport performance and in most cases optimal competition results, the monitoring and control can be structured by the coach through individualized approach taking into account the specific goals defined in an athlete's programme. It means that what should be observed by the coach, measured and controlled might vary for different athletes. The focus for a certain athlete might be put to motor skills, technique, power, or any other area of the performance where the athlete needs to improve/progress.

When monitoring and controlling the athletes 'performance the coach needs to collect data at the beginning of the programme, setting the baseline to compare the defined by the coach criteria for achievements later. Data collected throughout the programme timeframe is a good base to reassess the programme in the 5-step cycle of programme design (*see 3.3 above*).

5. Writing programme: Modifiable variables

One of the most important parts of the training programme are the modifiable variables that can affect the adaptation in the athlete, as desired by the coach. As mentioned in section 3.3 those

variables are: ***choice of exercises, order of exercises, volume, intensity, frequency, rest, progression, execution***.

5.1. **Exercise choice** – depending on the exercise the coach chose, this will influence in part the adaptation - choosing movement patterns, contraction times/types, movement planes, etc. It also requires the coach to think "what other variables do I have to think and account for prior to determine exercise choice", for example, what is the specifics of the track event, energy systems, sport specificity movements, anthropometrics, injury history of the athlete or potential/common sport specific injuries that might happen, so choosing specific exercises to prevent/minimize the risk of such. Another thing to consider when choosing exercise is what is the athlete age and level of experience - do we have enough time (according to the timeframe) to learn new complex exercise for specific adaptation or we can achieve that by an exercise already learnt by the athlete. For example, introducing an Olympic weightlifting exercise (eg, snatch) without enough time in the training cycle for the athlete to master proper technique would harm the athlete rather than achieve the desired adaptation. In such a case, it is more reasonable for the coach to look for another type of exercise that is already well mastered by the athlete.

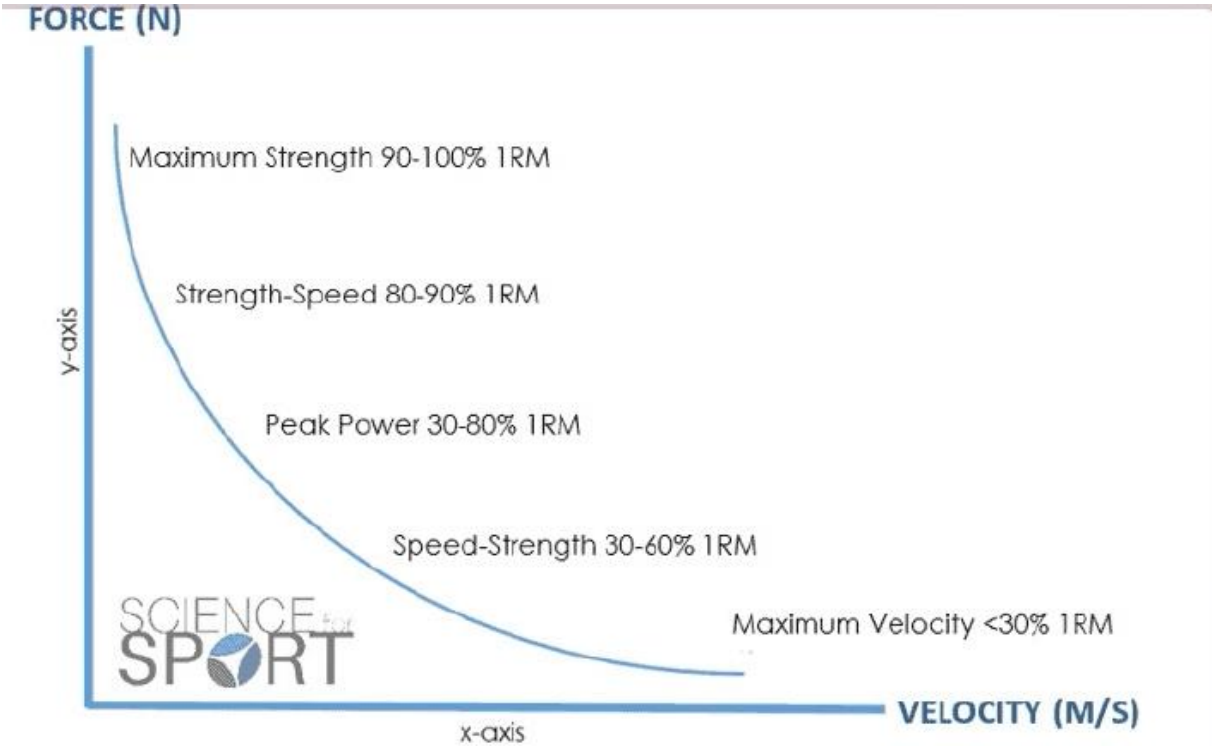
5.2. **Exercise order** – structuring the training session in order to get the most out of each workout. To be considered also when an athlete should perform multiple training sessions in a day – the order of those sessions should be prioritized as per the goal/adaptation required. **As a basic concept to be followed: do the most important workout/exercises (as defined by the coach) first. On a second layer, programme the most neurologically demanding exercises first (skill, technique, power, speed) where motor control is crucial, and the precision is high and the least neurologically demanding – at the end of a workout.** Or for example in a strength training session consider the prioritization of the multi-joint movements at the beginning of the workout, then focus on single joint ones, and similarly – large muscles before small muscles.

5.3. Volume – repetitions and sets to be performed, commonly planned on a weekly basis. Volume is highly tight to intensity (p. 5.4). As the intensity goes up, the volume will go down since the reps will be less, and vice versa. Depending on the goal, for example "strength", the programme has to include more intensity and to reduce the volume. **Each training adaptation has similar logic in the sense that depending on what the goal is the coach has to push and pull volume and intensity to achieve the desired outcome.**

5.4. **Intensity** – the load applied within a session (commonly planned as an average weekly percent of load or percent of 1 rep max), highly tight to volume and inversely related as mentioned in point 5.3.

As mentioned, volume and intensity are closely tight to each other, and coaches can use those variables also in situations when the athlete has some limitations for his/her daily performance (for example, being too tired, not well recovered, psychological barriers, or anything that compromise the athlete's performance). Based on the daily goal of the workout, the coach might either cut the volume, but preserve the intensity of the training session (if for example strength and/or power is the goal) or to keep the volume and reduce the intensity (if conditioning is the desired outcome).

Coaches have to be familiar with the Force-velocity curve when designing programmes:



(source: Science for Sport, https://www.scienceforsport.com/force-velocity-curve/)

In addition, when considering the volume and intensity in the training programme, the coaches might refer to A. S. Prilepin's chart (Sport scientist):

Prilepin's Chart

Percent of 1RM	Reps per Set	Optimal Total Reps	Range of Reps
55% - 65%	3-6	24	18 - 30
70% - 80%	3-6	18	12 - 24
80% - 90%	2-4	15	10 - 20
90%	1-2	7	4 - 10

1RM = 1 Repetition Maximum

5.5. **Frequency** - commonly planned on a weekly basis, days per week and/or number of training sessions per day and where applicable, according to the sport calendar – off-, pre-season, etc.

5.6. **Rest** – the rest intervals in-between repetitions and sets in the training session. Depending on the desired outcome/goal, the coach should plan the rest intervals. For example, typically speed, power, strength require rest intervals in-between 90 seconds up to 5 minutes with full/complete rest. As for the endurance and conditioning the rest might be reduced or even eliminated, as the goal will be to establish the ability of the athlete to handle fatigue.

5.7. Progression – overall progression throughout the year/periodization**.** This modifiable variable can be viewed as almost the opposite of the "exercise order" (point 5.2) where typically speed, strength, power are prioritized first, with the progression the beginning phase of the training year/programme puts the focus on the conditioning first, building the aerobic base of the athlete, preparing the tendons and connecting tissue of the athlete for advanced training and then progressing to strength and power and converting it into speed, for the final phase to execute in a sport event/competition.

5.8. **Execution** – how the athlete executes the training programme and the individual exercises. The coach should ensure that the athlete understands the purpose of the exercise, what outcome/adaptation it is designed to achieve, what is the proper technique to achieve that outcome; the movement quality – for example, correct sequence for firing/activating muscles, firing the right muscles at the right time when performing exercise, stability of the movement, symmetry, awareness of the athlete and focusing on the proper execution; desired range of motion; speed or tempo of the performance. All these are needed for the optimal performance and minimizing the risk of injury and need to be planned in the programme.

6. Speed related specifics in the programme design

Some exercises have gained theoretical and practical application in the speed development of athletes. Plyometrics being such type of exercise have been proven to contribute significantly for it. Still overdoing of plyometrics would prone the athlete to possible injuries. A very good clinical commentary was done and published by the International Journal of Sports Physical Therapy (full text is available here: CURRENT CONCEPTS OF PLYOMETRIC EXERCISE - PMC (nih.gov)) where clear **guidelines for appropriate plyometric training volume based on experience were developed. These guidelines provide a good starting point for coaches to design their programmes.**

The guidelines consider the level of the athlete as well as the complexity of the exercise:

Table 4.

Plyometric exercise volume (foot contacts) based on athletic ability.

Beginner	Intermediate	Advanced
80-100	100-120	120-140

aData taken from: Chmielewski, Myer, Kauffman, Tillman[1]

Table 5.

Plyometric exercise volume (foot contacts) based on exercise intensity.

Low	Moderate	High	Very High
400	350	300	200

Data taken from: Chmielewski, Myer, Kauffman, Tillman[1]

Table 6.

Examples of progression of plyometric activities for the lower extremity.

Squat jumps (Figure 1)	Jump and reach	Depth jumps (Figure 6)
Split squat jumps (Figure 2)	Medial and lateral jumps	Box jumps
Bilateral mini jumps	Anterior and posterior jumps	Single leg hops (Figure 7)
Skipping	Double leg tuck jumps (Figure 4)	Single leg tuck jumps
Lateral bounding (Figure 3)	Pike jumps	Drop jump to second box
Ankle bounces	Jumping to box (Figure 5)	Squat depth jump
Shuffling	Zigzag jumps	
In place jumps	Side to side push off jumps	
Single leg push off box	Step from box	

Source: Tables 4, 5 and 6, CURRENT CONCEPTS OF PLYOMETRIC EXERCISE - PMC (nih.gov)

7. Conclusion

The fundamental goal of sport is and should always be health oriented. When pursuing high and optimal sport performance the health of the athlete should be the priority of the coaches (and other team members). Solid theoretical and practical knowledge of the coaches is absolute must when designing an optimal training programme for physical preparation of athletes to the extent that “do no harm” is always ensured in their work. This methodology provides important extracts for practical application of tools and methods for designing training programmes in sprinting track events. It should be clearly recognised that continuous learning by the coaches is needed in order to achieve optimal results with their athletes and not restrict their education and knowledge to limited training resources but to always stay on track with recent publications research, technologies, etc.

Annex 1 Additional resources

Useful links for extended knowledge and information:
International Society Of Sports Nutrition (sportsnutritionsociety.org)

CURRENT CONCEPTS OF PLYOMETRIC EXERCISE - PubMed (nih.gov)

Science for Sport, https://www.scienceforsport.com/force-velocity-curve/

Sport: Journals & Databases -

Journals & Databases - Sport - Library Guides at The Library, TUS Midwest (libguides.com)

Exercise Science Database - Exercise Science Databases - Exercise Science Databases - Research Guides at University of North Carolina at Charlotte

World Athletics Library - Library | World Athletics | World Athletics

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Annex 2

Demo of the methodology on training programme

Plyometrics

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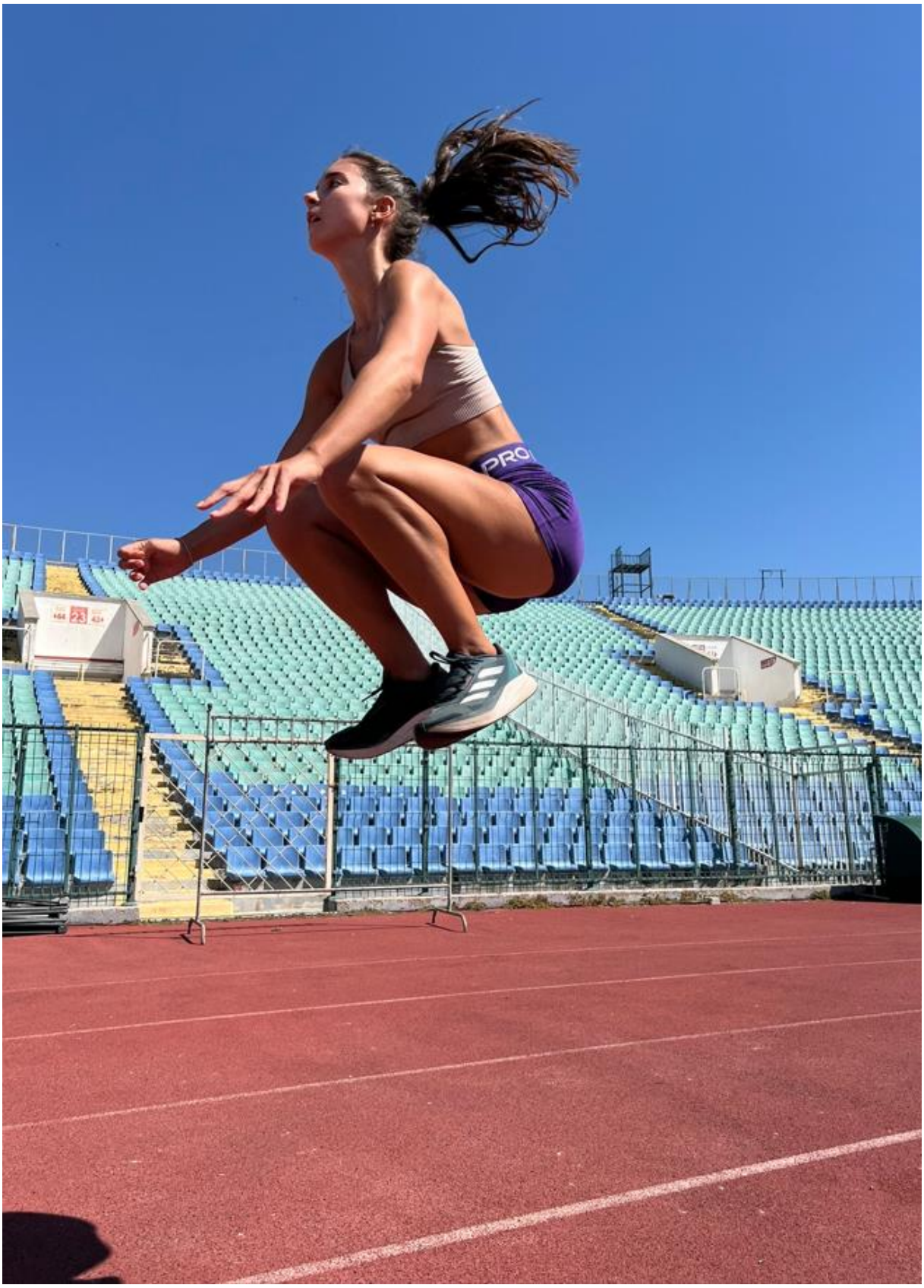

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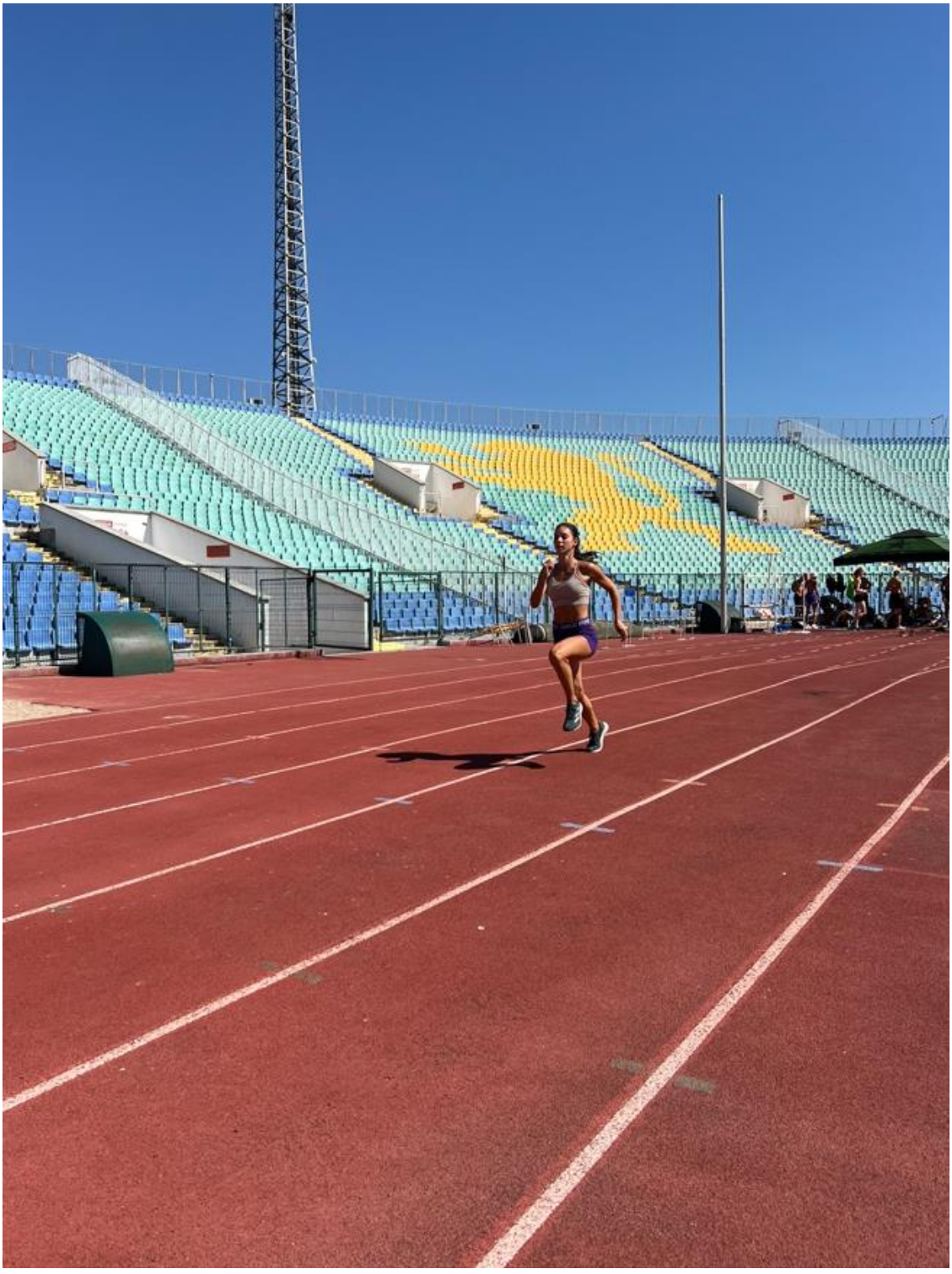
Drills



Strength

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Power

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